

Instructions: Upload LEGIBLE, COMPLETE solutions to Gradescope before 11:59pm on 22 October 2021.

1. Compute the direction of maximum increase of $f(x, y, z) = \frac{x}{y+z}$ at the point $p = (-1, 3, -1)$.
2. Classify the critical points of each of the following functions.
 - (a) $f(x, y) = x^2 + y^4 + 2xy$
 - (b) $f(x, y) = x^3 + y^3 - 3x^2 - 3y^2 - 9x$
3. Compute the global extrema of $f(x, y) = x + y - xy$ on the triangular region with vertices $(0, 0)$, $(0, 2)$, and $(4, 0)$.
4. Compute the global extrema of $f(x, y, z) = xy^2z$ subject to the constraint $x^2 + y^2 + z^2 = 4$.
5. Compute each of the following integrals.
 - (a) $\iint_D y \exp(-xy) \, dA$ where $D = [0, 2] \times [1, 3]$
 - (b) $\iint_D y \sqrt{x^2 - y^2} \, dA$ where D is the triangle with vertices $(0, 0)$, $(2, 0)$, and $(2, 2)$
 - (c) $\iint_D \frac{y^2}{x^2 + y^2} \, dA$ where D lies between the circles $x^2 + y^2 = 1$ and $x^2 + y^2 = 16$